US006357150B1

(12) **United States Patent**
**Satzler**

(10) **Patent No.: US 6,357,150 B1**
(45) **Date of Patent: Mar. 19, 2002**

(54) **SPADE WHEEL APPARATUS FOR DREDGING EQUIPMENT AND ASSOCIATED METHOD**

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( * ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/529,693**

(22) PCT Filed: **Mar. 24, 2000**

(86) PCT No.: **PCT/US00/07951**

§ 371 Date: **Apr. 18, 2000**

§ 102(e) Date: **Apr. 18, 2000**

(51) **Int. Cl.**[7] ..... **E02F 3/08**
(52) **U.S. Cl.** ..... **37/337**; 37/352; 37/190
(58) **Field of Search** ..... 37/91–93, 189, 37/190, 309, 337, 338, 347, 348, 350–355, 901; 172/39, 55, 559

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(57) **ABSTRACT**

A rotating drive wheel assembly for steering and maneuvering a dredging apparatus includes a carrier wheel and an orientation wheel connected to opposite ends of a pivotation member. A plurality of spade devices are connected to the wheels, each including a blade portion pivotally coupled to a spoke plate of the carrier wheel, and an arm portion pivotally coupled at opposite ends to the outer portion of the carrier wheel and another carrier wheel spoke plate member. The construction of the present drive wheel assembly allows the spade devices to remain in a substantially vertical orientation when the carrier wheel is rotated about its axis of rotation.

**31 Claims, 3 Drawing Sheets**

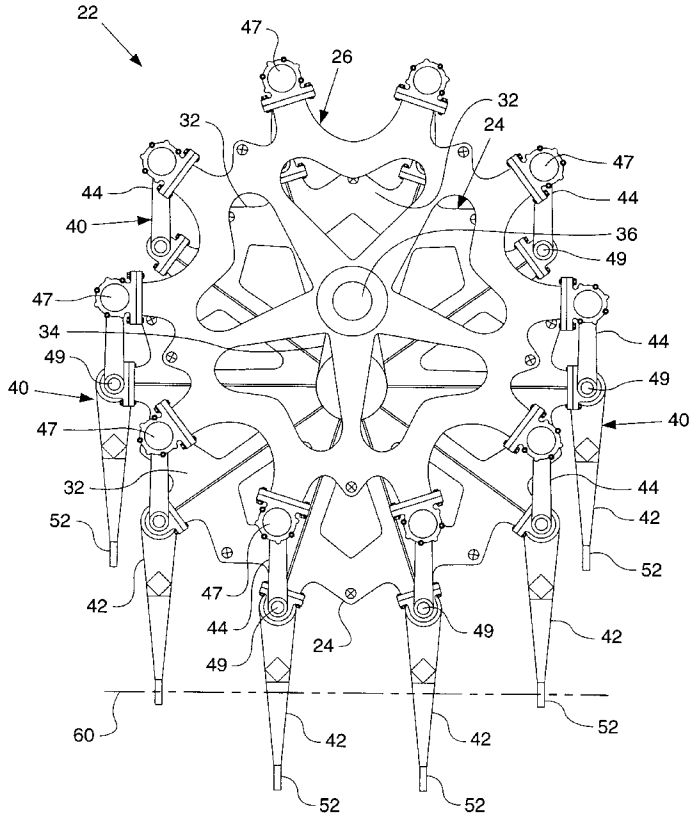

Fig. 1

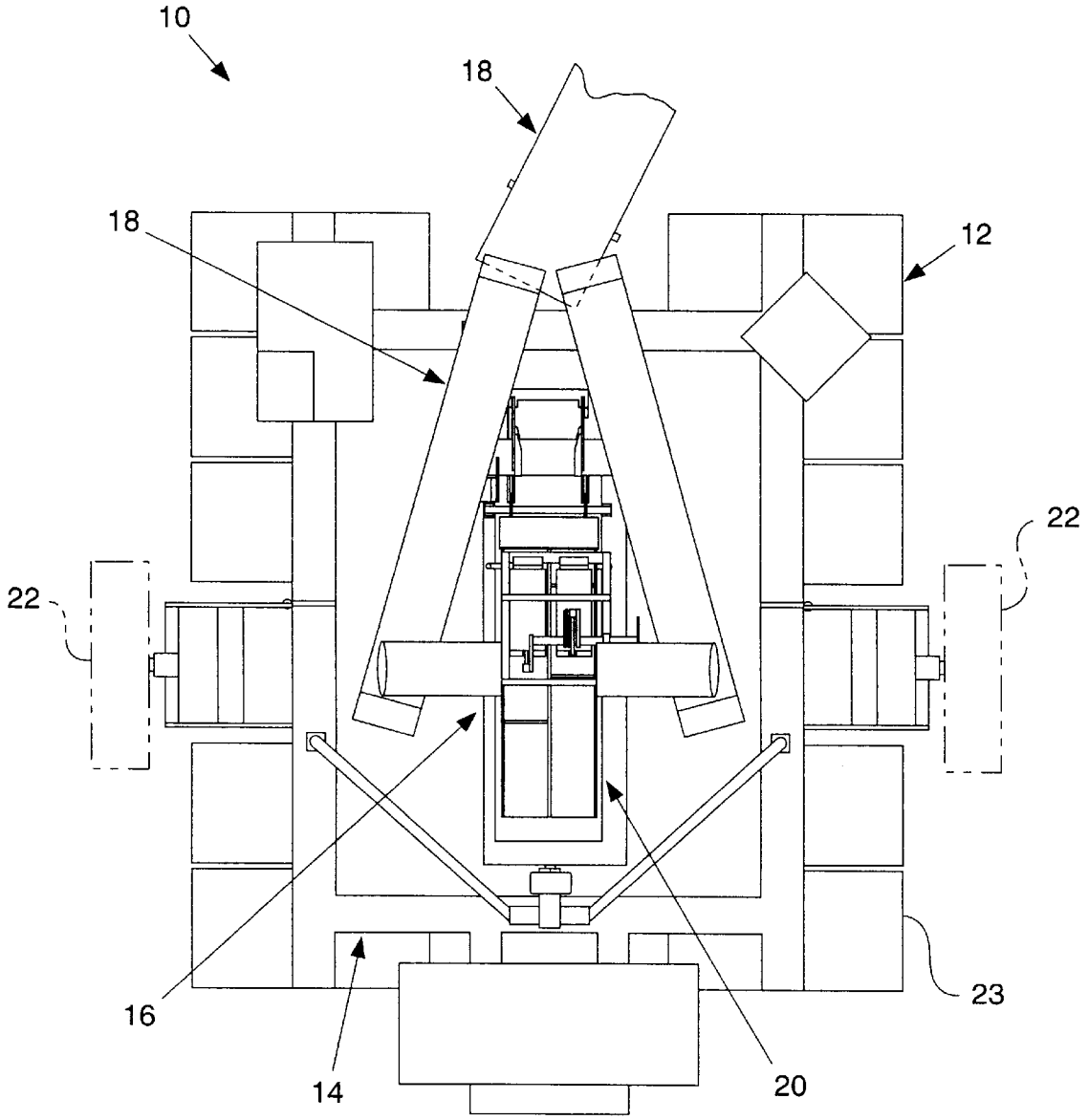

Fig. 2

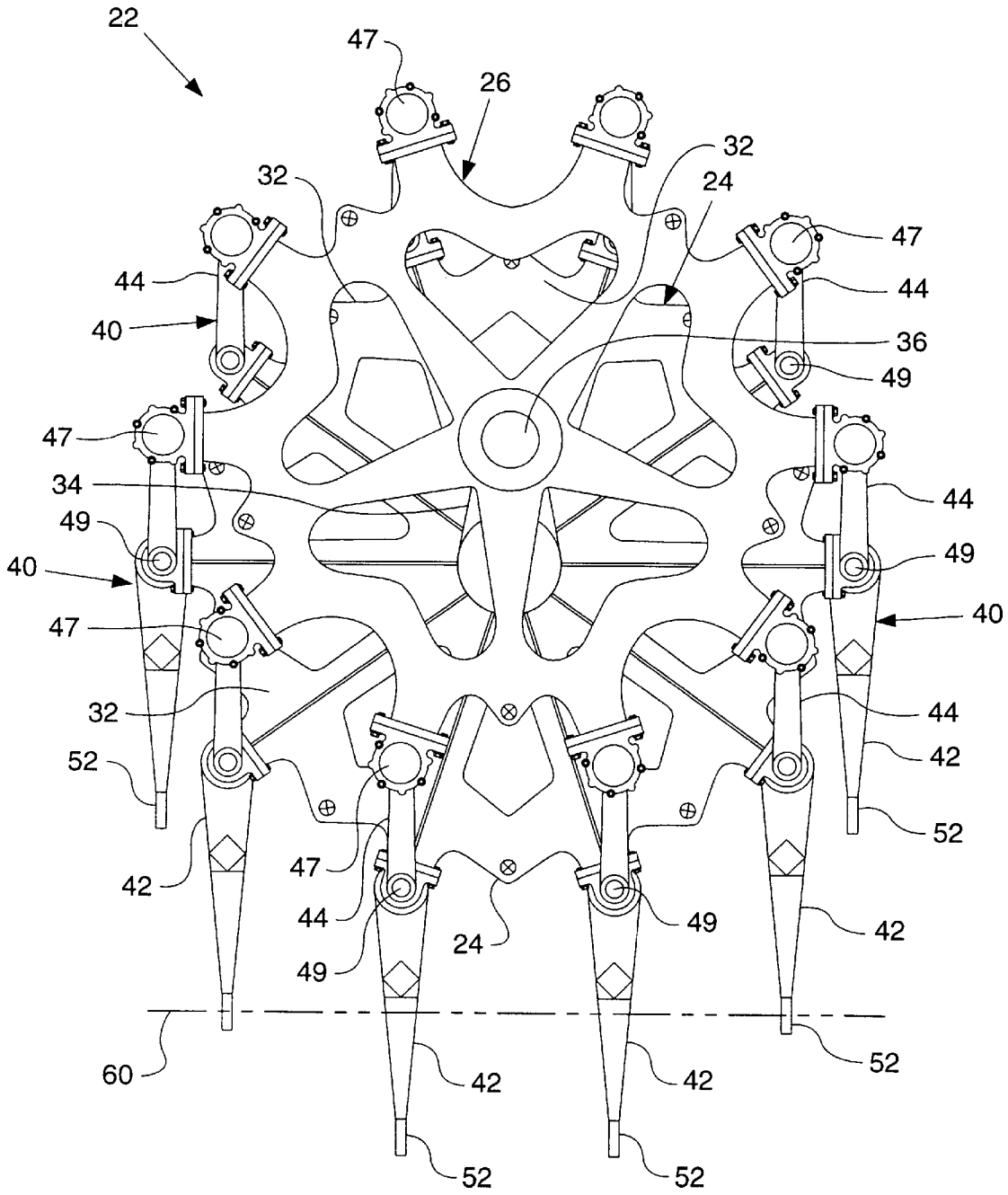
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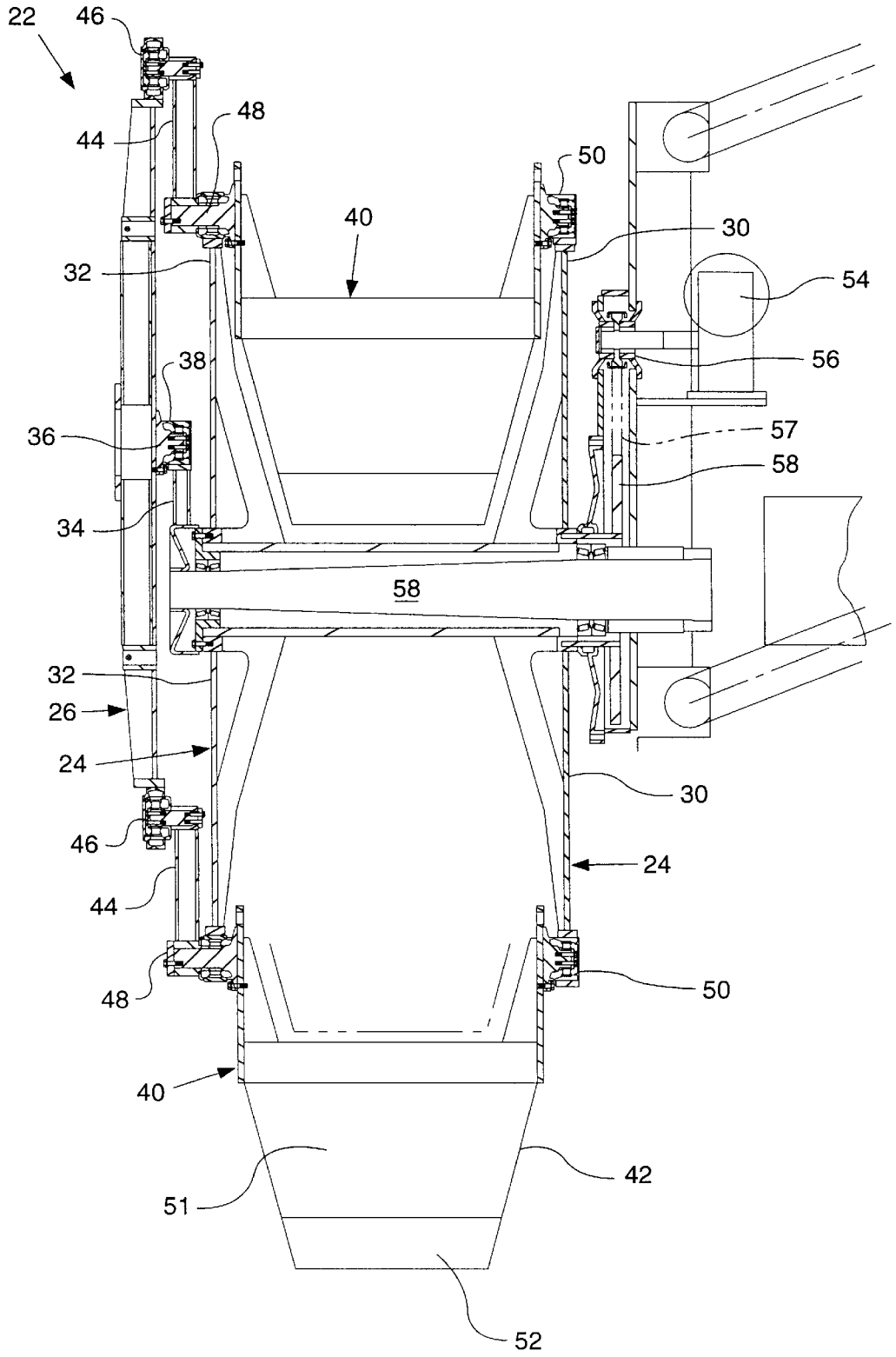
Fig. 3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# SPADE WHEEL APPARATUS FOR DREDGING EQUIPMENT AND ASSOCIATED METHOD

## TECHNICAL FIELD

This invention relates generally to locomotion mechanism for dredging apparatus and associated method and, more particularly, to a spade wheel mechanism for propelling and maneuvering dredging apparatus in a body of water.

## BACKGROUND ART

Various types of dredging apparatus are known in the art for removing silt, sand, mud or other sediment material from the bottom of a body of water. One such dredging apparatus is disclosed in U.S. Pat. No. 5,960,570 and includes a floatation arrangement operative to float on the surface of the body of water, a frame structure mounted on the floatation arrangement, and a silt excavating wheel mechanism rotatably mounted to the frame structure and operative to extract silt from under the body of water. Such apparatus also typically includes a height adjustment mechanism operative to raise and lower the excavating wheel mechanism relative to the surface of the water and may include a conveyor arrangement operative to transport the extracted silt away from the excavating wheel mechanism.

Typically, dredging apparatus likewise have mechanisms and/or systems for propelling and maneuvering the apparatus relative to the floor of the body of water. Usually, such drive mechanisms include a pair of drive wheels positioned one on each side of the dredging equipment to engage the floor of the body of water in order to propel and maneuver the dredging equipment relative thereto. However, due to the relatively loose, soft and slippery material typically present on the floor surfaces of bodies of water, the drive wheels may not always properly engage the floor surface whereby propelling or maneuvering such heavy equipment relative thereto becomes difficult, cumbersome and inefficient. Further, the contact between the drive wheels and the floor surface results in displacement of the relatively loose sediment material present at the floor surface into the surrounding water. Sediment material thus displaced causes undesirable turbidity in the surrounding water, which is particularly undesirable in the vicinity of the dredging wheel mechanism. It is accordingly preferable to minimize the amount of turbidity caused by the drive wheel mechanism associated with dredging apparatus during a dredging operation.

Therefore, it is desirable to provide a drive wheel mechanism for dredging apparatus which reliably engages the floor of a body of water during dredging operations, which permits efficient propulsion and navigation of the dredging apparatus relative to the floor of the body of water, and which does not cause turbidity in the vicinity of the dredging wheel mechanism during a dredging operation.

Accordingly, the present invention is directed to overcoming one or more of the problems as set forth above.

## DISCLOSURE OF THE INVENTION

In one aspect of the present invention a drive wheel assembly adapted for use for propelling a dredging apparatus in a body of water is disclosed. The drive wheel assembly includes a carrier wheel rotatably coupled to the dredging apparatus, the carrier wheel including an axis member at the center thereof defining the center of rotation of the carrier wheel, a first member coupled to one end of the axis member and a second member coupled to the other end of the axis member, a pivotation member having opposed end portions, one end portion of the pivotation member being coupled to the center axis member of the carrier wheel, an orientation wheel pivotally connected to the opposed end portion of the pivotation member, and a plurality of spade devices pivotally connected to the carrier wheel and to the orientation wheel, each spade device including an arm portion and a blade portion, each arm portion having opposed end portions, one end portion of each arm portion being pivotally coupled to the orientation wheel and the opposite end portion of each arm portion being pivotally coupled to the first member associated with the carrier wheel, each blade portion having a portion thereof pivotally coupled to the second member associated with the carrier wheel whereby the spade devices are positioned in a substantially vertical orientation relation to the horizontal.



In another aspect of this invention, a method for assembling a drive wheel assembly adapted for use for propelling a dredging apparatus in a body of water is disclosed. The method includes the steps of rotatably coupling a carrier wheel to the dredging apparatus, the carrier wheel including an axis member at the center thereof defining the center of rotation of the carrier wheel, coupling a first member to one end of the axis member, coupling a second member to the other end of the axis member, pivotally connecting an orientation wheel to the opposed end portion of a pivotation member, the pivotation member having opposed end portions, one end portion of the pivotation member being coupled to the center axis member of the carrier wheel, pivotally connecting a plurality of spade devices to the carrier wheel and to the orientation wheel, each spade device including an arm portion and a blade portion, each arm portion having opposed end portions, pivotally coupling one end portion of each arm portion to the orientation wheel, pivotally coupling the opposite end portion of each arm portion to the first member associated with the carrier wheel, pivotally coupling each blade portion having a portion thereof to the second member associated with the carrier wheel, and positioning the spade devices in a substantially vertical orientation relation to the horizontal.

## BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the present invention, reference may be made to the accompanying drawings in which:

FIG. **1** is a partial top elevational view of a typical dredging apparatus incorporating the present invention;

FIG. **2** is a side view of a drive wheel assembly constructed according to one embodiment of the present invention; and

FIG. **3** is a front elevational view of the drive wheel assembly illustrated in FIG. **2**.

## BEST MODE FOR CARRYING OUT THE INVENTION

Referring to the drawings, FIG. **1** discloses a portion of a dredging apparatus **10** which is adapted to remove silt from under a body of water, the apparatus **10** including a floatation arrangement **12**, a base frame structure **14** connected to floatation arrangement **12**, a silt excavating wheel mechanism **16** operative to remove silt from underneath the body of water, a pair of shield/shoe mechanisms (not shown) operative to shield wheel mechanism **16** from the water while silt is being removed from the bottom of the body of water, an ejector mechanism **20** operative to aid in the removal of silt from wheel mechanism **16**, and two drive

wheel assemblies **22** operative to propel and maneuver apparatus **10** in a body of water. A typical dredging apparatus such as apparatus **10** would also include a conveying system **18** operative to transport the silt away from the wheel mechanism **16**.

Floatation arrangement **12** includes a plurality of individual floats **23** interconnected to each other by frame structure **14** to form a base platform. Floatation arrangement **12** also includes a buoyancy control arrangement operative to control the level of the platform by increasing or decreasing the buoyancy of at least certain ones of the plurality of floats **23** in order to compensate for changes in weight distribution. The silt excavating wheel mechanism **16** includes a wheel frame assembly pivotally connected to frame structure **14** at a plurality of pivot points (not shown), and a height adjusting mechanism (not shown). Apparatus **10** will typically also include a conveyor system **18** to transport excavated silt away from apparatus **10** and, in that regard, a wide variety of different types of conveyor systems can be utilized with dredging apparatus **10** without departing from the spirit and scope of the present invention. An appropriate conveyor mechanism such as conveyor system illustrated in U.S. Pat. No. 5,960,570 would be operatively located to receive the removed silt from the silt removal wheel mechanisms and thereafter transport and deposit such silt at an appropriate storage location such as onto a barge or some other transporting device.

In addition, a typical dredging apparatus will include a propulsion and steering system. These systems typically include a pair of independent drive wheel assemblies **22** operable to both propel the dredging apparatus **10** as well as steer apparatus **10** in a body of water. Referring to FIGS. **2** and **3**, a drive wheel assembly **22** constructed according to the teachings of one embodiment of the present invention is shown. Each drive wheel assembly **22** is preferably adjustably connected to apparatus **10** whereby the height of wheel assembly **22** relative to apparatus **10** is variable and adjustable such that apparatus **10** may be operable in bodies of water having a variety of depths. It is recognized and anticipated that any position or height adjustment mechanism known in the art may be utilized for this purpose such as those mechanisms disclosed in U.S. Pat. Nos. 5,907,915 and 5,960,570. It is, however, recognized and anticipated that drive wheel assemblies **22** may also be fixed relative to apparatus **10** in particular embodiments of the present invention.

Drive wheel assembly **22** includes a carrier wheel **24**, and an orientation wheel **26** which is positioned vertically or radially offset relative to carrier wheel **24**. Carrier wheel **24** includes an axis member **28** at the center thereof and two spoked plate members **30** and **32** connected respectively to the opposite ends of axis member **28**. Plate members **30** and **32** are preferably substantially identical to each other, the plate members **30** and **32** connected to axis member **28** being clearly illustrated in FIG. **3** while only portions of plate member **32** are visible in FIG. **2**. A pivotation or linkage member **34** is rigidly connected to axis member **28** at one end portion thereof and its other end portion **38** which includes a pivot mechanism **36** is pivotally connected to the center of orientation wheel **26**. As a result, pivot mechanism **36** is substantially vertically or radially offset relative to axis member **28**. It can be appreciated that member **34** provides a substantially vertical or radial offset between wheels **24** and **26** by approximately the same distance as the length of the member **34**.

Referring to FIGS. **2** and **3**, drive wheel assembly **22** also includes a plurality of spade devices **40**, each of which is connected to both wheels **24** and **26**. Each spade device **40** includes a blade portion **42**, an arm portion **44**, an orientation wheel pivot mechanism **46**, and a pair of carrier wheel pivot mechanism **48** and **50**. In the preferred embodiment, each spade device **40** and its various components are constructed integrally in order to provide durability and strength to the overall spade device **40** as well as to the interrelationships amongst its various components. However, it is recognized and anticipated that the various components may be individually distinct and substantially rigidly connected to each other.

Blade portion **42** of each spade device **40** is shown as being of a trapezoidally shaped plate member **51** with a relatively flat surface area on each side thereof, the plate member **51** having tapered side edges that conclude in a tip portion **52**. The tapered side edges of plate member **51** narrow as the member **51** approaches tip portion **52** as best shown in FIG. **2**. In this regard, the tapered side edges of the spade devices **40** are best illustrated in FIG. **2** whereas the trapezoidal shape and surface area of plate member **51** is best illustrated in FIG. **3**.

Arm portion **44** includes a longitudinal member having pivot mechanism **46** positioned at one end portion thereof and pivot mechanism **48** positioned at its opposite end portion. Pivot mechanism **46** is pivotally connected to an outer edge of orientation wheel **26** at a pivot point **47** and pivot mechanism **48** is pivotally connected to a corresponding pivot point **49** associated with plate member **32** of carrier wheel **24** as best illustrated in FIG. **2**. Pivot mechanism **50** associated with each spade device **40** is similarly pivotally connected to an outer edge of the plate member **30** associated with carrier wheel **24** at a corresponding pivot point (not shown) similar to pivot point **49**. When thus connected, each spade device **40** is oriented in a substantially vertical position regardless of the particular position of the spade devices **40** on the circumference of wheel assembly **22**. Such vertical orientation is due to the vertical or radial offset between carrier wheel **24** and orientation wheel **26** by virtue of the substantially rigid member **34** positioned and coupled therebetween. The pivot points **47** at the outer edges of orientation wheel **26** and the pivot points **49** associated with the plate members **30** and **32** forming carrier wheel **24** must all be at a substantially identical radius, or distance, from the center axis of rotation of the respective wheels **24** and **26** in order for the spade devices **40** to remain substantially vertically oriented during 360° of rotation of the wheels **24** and **26**.

In the particular embodiment of the present invention illustrated in FIGS. **2** and **3**, there are ten spade devices **40** positioned in spaced apart relationship about the outer circumference of wheels **24** and **26**. However, it is recognized and anticipated that the total number of spade devices **40** and the positioning thereof on wheels **24** and **26** may be varied to accommodate the particular requirements of a particular body of water, or to conform to the particular requirements or design of another embodiment of the present drive wheel assembly **22**. For example, it might be preferable to have more than ten spade devices **40** in an embodiment having wheel assemblies **22** of a comparatively larger diameter for operation in deeper bodies of water and vice versa. Also, the opposed end portions of arm portion **44** may be pivotally coupled to the orientation and carrier wheels at locations other then the respective outer edge portions of orientation wheel **26** and carrier wheel plate members **30** and **32**.

A drive mechanism is preferably provided to rotate carrier wheel **24** about axis member **28**. It is recognized and

anticipated that any suitable transmission, driving device or drive mechanism known in the art may be used to drive carrier wheel **24**. In the embodiment illustrated in FIG. **3**, a high reduction transmission gear box **54** is shown coupled to carrier wheel **24** and axis member **28** via chain sprocket **56** and roller chain **57**. Other drive mechanisms can likewise be utilized. Further, in the preferred embodiment, the carrier wheel **24** associated with each wheel assembly **22** is independently controllable, and preferably may be driven in either a forward or a rearward direction.

During operation in a particular body of water, drive wheel assemblies **22** of the dredging apparatus **10** are preferably lowered to a height under the surface of the water wherein the spade devices **40** located at the bottom portion of wheel assemblies **22** engage the floor surface **60** (FIG. **2**) of a particular body of water. The tapered blade portions **42** of the substantially vertical spade devices **40** along with their narrow tip portions **52** vertically penetrate the comparatively soft or loose material associated with the floor surface **60**. Such vertical penetration of the blade portions **42** will not agitate the sediment material of floor surface **60** because the blade portions **42** first penetrate the floor surface vertically with the relatively narrow tip portions **60**, and thereafter penetrate the floor surface with the tapered side edges of blade portion **42**. As a result, the spade devices **40** enter and exit the floor surface **60** in a substantially vertical position thereby causing less of a disturbance or agitation as the spade devices **40** enter and exit the floor sediment. In this regard, the member **44** functions to maintain the vertical orientation of the spade devices **40** as they rotate about the wheel assemblies **22** as previously explained. The present drive wheel assemblies **22**, including spade devices **40**, therefore do not travel horizontally against the floor surface **60** as might occur with a conventional drive wheel assembly thereby agitating the sediment material at the surface of floor **60**.

In order to propel or maneuver the dredging apparatus **10** across a body of water, the drive mechanism such as mechanisms **54**, **56** and **58** rotate carrier wheel **24** of wheel assembly **22** in a desirable direction at a desirable speed. Those skilled in the art will appreciate that the rotation of carrier wheel **24** in a wheel assembly **22** will cause orientation wheel **26** in that wheel assembly **22** to rotate therewith at a substantially identical angular velocity. This is in part due to the vertically or radially offset position of orientation wheel **26** with respect to carrier wheel **24** which is maintained by pivotation member **34**, and in part due to the pivotable connections of the arm portions **44** associated with each spade device **40** with orientation wheel **26** and carrier wheel **24**. As carrier wheel **24** rotates, the arm portions **44** convey the motion to orientation wheel **26** whereby orientation wheel **26** rotates therewith. Since the arm portions **44** are pivotally connected to both wheels, and since the distance between corresponding pivot points **47** and **49** on plate member **32** and orientation wheel **26** remain constant, that is, at a substantially identical vertically or radially offset distance with respect to each other, throughout rotation of the drive wheel assembly **22**, spade devices **40** will pivot with respect to each wheel **24** and **26** as the wheels rotate, and the spade devices **40** will maintain their substantially vertical orientation throughout rotation of such wheels. In this regard, those skilled in the art will appreciate that the radius of each corresponding pivot point **47** and **49** on spoked plate member **32** and on orientation wheel **26** must be at a substantially identical radius from the center axis of the respective wheels in order for spade devices **40** to maintain their substantially vertical orientation during rotation of the wheels. With this configuration, spade devices **40** will maintain their substantially vertical orientation regardless of the angular position of the carrier wheel **24** and orientation wheel **26** relative thereto, and the spade devices **40** will maintain such substantially vertical orientation throughout a 360° rotation of carrier wheel **24** and orientation wheel **26**.

As the carrier wheel **24** of each drive wheel assembly **22** is rotated, the substantially flat surface areas of blade portions **42**, when buried in the sediment material under floor surface **60**, push horizontally against the sediment material below the surface thereof. This horizontal pushing force is in significant part due to the vertical position of the spade devices **40** maintained by the offset relationship between the carrier wheel **24** and the orientation wheel **26**. Those skilled in the art will appreciate that the force of the sediment material against blade portions **42** propels dredging apparatus **10** in a direction commensurate with such force. As the drive wheel assembly **22** continues to rotate, apparatus **10** is propelled relative to floor **60**, and the blade portions **42** associated with the spade devices **40** located at the front portion of wheel assembly **22** strike and enter the surface of floor **60** in a substantial vertical position whereas the blade portions **42** associated with the spade devices **40** located at the back portion of wheel assembly **22** exit the floor surface **60** in a substantially vertical position, substantially opposite to the direction in which they entered and penetrated the floor **60**. Such vertical penetration and exit from the sediment material causes a considerably minor amount of turbidity in the surrounding water. This cycle of vertical penetration of spade device **40** into floor surface **52**, pushing horizontally against the sediment material under floor surface **60**, and vertical exit thereof continues to repeat itself as the drive wheel assembly **22** continues to rotate.

Dredging apparatus **10** is thus propelled, which, as those skilled in the art will appreciate, may be propelled in either a forward or a rearward direction as the wheel assemblies **22** and spade devices **40** thereon will perform substantially identically in either direction of rotation of wheel assemblies **22**. Further, controlling the rotation of each wheel assembly **22** independently will allow the dredging apparatus **10** to be maneuvered as desired, such as by moving one wheel assembly **22** faster or slower as compared to another wheel assembly **22**.

Industrial Applicability

As described herein, the method and apparatus of the present invention has particular utility in all types of dredging operations and equipment wherein it is desirable to provide locomotion capability thereto. Typically, the wheel assemblies **22** of the present invention will be positioned and located one on each side of a dredging apparatus. However, it is recognized that any plurality of wheel assemblies **22** may be utilized with a particular dredging apparatus **10**. For example, a relatively large dredging apparatus may have three or more drive wheel assemblies associated therewith. Accordingly, such variations and embodiments of the present invention are recognized and anticipated, and therefore it is intended that the claims shall cover all such embodiments of the present invention that do not depart from the spirit and scope of the present invention.

Those skilled in the art will appreciate that dredging apparatus having wheel assemblies according to the present invention can be navigated in a body of water by independently controlling the rotation of two or more wheel assemblies. If all wheel assemblies in a particular dredging apparatus rotate at the same speed and in the same direction, the dredging apparatus will be propelled commensurate with

such rotation of the wheel assemblies. However, if one wheel assembly is turned faster or slower as compared to another wheel assembly positioned offset relative thereto, the dredging apparatus will be steered or turned in the direction of the net result of the independent propulsion contributed by each wheel assembly. Accordingly, desirable navigational capabilities may be achieved in a particular dredging apparatus by having the drive wheel assemblies **22** of the present invention function in cooperation with appropriate individual control mechanisms for each individual wheel assembly **22**. Further, those skilled in the art will appreciate that the dredging apparatus may be propelled in either a forward or a rearward direction by controlling the direction of rotation of the wheel assemblies thereon. The present spade devices **40** will maintain their substantially vertical orientation and will penetrate and exit the floor of a particular body of water in substantially the same manner as described above regardless of the direction of travel. Accordingly, the wheel assemblies **22** of the present invention are suitable for dredging apparatus operable to conduct dredging operations in both a forward and a reverse direction of travel.

Tip portion **52** associated with each spade device **40** is preferably narrow and strong. During operation of drive wheel assembly **22**, the tip portions **52** will strike the floor **60** of a body of water first, and the remainder of the blade portions **42** will follow therebehind. In the event that tip portion **52** encounters an object such as a rock or a piece of debris either at the floor surface or underneath the floor surface of a particular body of water, the narrow tip portion **52** should be sufficiently strong to either pierce through the object or to edge it aside whereby the tapered side edges of blade portions **42** may continue to push off of the sediment of floor surface **60** to achieve the desired propulsion. Accordingly, the narrow shape of tip portion **52** and the tapered side edges of blade portion **42** provide additional utility aside from the fact that the design and shape thereof result in a substantially reduced amount of turbidity during operation in a body of water.

It is recognized that variations to the construction and design of the present drive wheel assemblies **22** can be made without departing from the spirit and scope of the present invention. In this regard, particular features could be added or particular features could be eliminated from the construction of the wheel assemblies **22**. In addition, as is evident from the foregoing description, certain aspects of the present invention are not limited by the particular details of the examples illustrated herein, and it is therefore contemplated that still other modifications and applications, or equivalents thereof, will occur to those skilled in the art. It is accordingly intended that the following claims shall cover all such modifications and applications that do not depart from the sprit and scope of the present invention.

Other aspects, objects and advantages of the present invention can be obtained from a study of the drawings, the disclosure and the appended claims.

What is claimed is:

**1**. A drive wheel assembly **(22)** adapted for use for propelling a dredging apparatus **(10)** in a body of water, the drive wheel assembly **(22)** comprising:

a carrier wheel **(24)** rotatably coupled to the dredging apparatus **(10)**, the carrier wheel **(24)** including an axis member **(28)** at the center thereof defining the center of rotation of the carrier wheel **(24)**, a first member **(32)** coupled to one end of said axis member and a second member **(30)** coupled to the other end of said axis member;

a pivotation member **(34)** having opposed end portions, one end portion of said pivotation member being coupled to the center axis member **(28)** of said carrier wheel **(24)**;

an orientation wheel **(26)** pivotally connected to the opposed end portion **(38)** of said pivotation member **(34)**; and

a plurality of spade devices **(40)** pivotally connected to said carrier wheel **(24)** and to said orientation wheel **(26)**, each spade device **(40)** including an arm portion **(44)** and a blade portion **(42)**, each arm portion **(44)** having opposed end portions **(46, 48)**, one end portion **(46)** of each arm portion **(44)** being pivotally coupled to the orientation wheel **(26)** and the opposite end portion **(48)** of each arm portion **(44)** being pivotally coupled to the first member **(32)** associated with said carrier wheel **(24)**, each blade portion **(42)** having a portion **(50)** thereof pivotally coupled to the second member **(30)** associated with said carrier wheel **(24)** whereby said spade devices **(40)** are positioned in a substantially vertical orientation relation to the horizontal.

**2**. The drive wheel assembly **(22)** as set forth in claim **1**, wherein said spade devices **(40)** remain in a substantially vertical orientation when said carrier wheel **(24)** is rotated about said axis member **(28)**.

**3**. The drive wheel assembly **(22)** as set forth in claim **1**, wherein the blade portion **(42)** of said spade devices **(40)** includes a plate member **(51)** having a substantially flat surface area with tapered side edges.

**4**. The drive wheel assembly **(22)** as set forth in claim **3**, wherein said blade portion **(42)** terminates in a tip portion **(52)**.

**5**. The drive wheel assembly **(22)** as set forth in claim **1**, wherein said first **(32)** and second **(30)** carrier wheel members are spoked members.

**6**. The drive wheel assembly **(22)** as set forth in claim **1**, wherein one end portion **(46)** of each arm portion **(44)** is pivotally coupled to an outer edge portion of said orientation wheel **(26)**.

**7**. The drive wheel assembly **(22)** as set forth in claim **6**, wherein the opposed end portion **(48)** of each arm portion **(44)** is pivotally connected to an outer edge portion of the first member **(32)** associated with the carrier wheel **(24)**.

**8**. The drive wheel assembly **(22)** as set forth in claim **7**, wherein a portion **(50)** of each blade portion **(42)** is pivotally coupled to an outer edge portion of the second member **(30)** associated with the carrier wheel **(24)**.

**9**. The drive wheel assembly **(22)** as set forth in claim **1**, further comprising a drive mechanism **(54, 56, 58)** to drive the carrier wheel **(24)**.

**10**. The drive wheel assembly **(22)** as set forth in claim **1**, wherein said pivotation member **(34)** provides a substantially vertical offset between the orientation wheel **(26)** and the carrier wheel **(24)**.

**11**. The drive wheel assembly **(22)** as set forth in claim **1**, wherein said pivotation member **(34)** provides a substantially radial offset between the orientation wheel **(26)** and the carrier wheel **(24)**.

**12**. The drive wheel assembly **(22)** as set forth in claim **1**, wherein said wheel assembly **(22)** is vertically adjustable with respect to the dredging apparatus **(10)**.

**13**. The drive wheel assembly **(22)** as set forth in claim **1**, wherein corresponding pivot connections **(47, 49)** on the orientation wheel **(26)**, the first member **(32)** associated with the carrier wheel **(24)**, and the second member **(30)** associated with the carrier wheel **(24)** are at a substantially

identical radius from the center axis of rotation of the respective wheels (24, 26).

14. The drive wheel assembly (22) as set forth in claim 1, wherein the rotation of the carrier wheel (24) drives the orientation wheel (26) at a substantially identical angular velocity.

15. The drive wheel assembly (22) as set forth in claim 1, wherein the plurality of spade devices (40) maintain their substantially vertical orientation at any angular position of said carrier (24) and orientation (26) wheels.

16. A drive wheel assembly (22) coupled to a dredging apparatus (10) for maneuvering the dredging apparatus (10) in a body of water, the drive wheel assembly (22) comprising:

a carrier wheel (24) rotatably connected to the dredging apparatus (10), said carrier wheel (24) including an axis member (28) defining the center of rotation of said carrier wheel (24) and a pair of first (32) and second (30) plate members coupled to said axis member (28) in spaced apart relationship relative to each other;

an orientation wheel (26) having an axis of rotation spaced from the axis of rotation of said carrier wheel (24);

a pivotation member (34) having opposed end portions, one end portion of said pivotation member being substantially rigidly connected to the axis member (28) of said carrier wheel (24) and the opposed end portion (38) of said pivotation member (34) being pivotally connected to said orientation wheel (26) at the axis of rotation thereof; and

a plurality of spade devices (40) pivotally connected to said carrier (24) and orientation (26) wheels, each spade device (40) including an arm portion (44) and a blade portion (42), each arm portion (44) having a pivot mechanism (46, 48) associated with each opposite end portion thereof, one pivot mechanism (46) associated with each arm portion (44) being pivotally coupled to an outer portion of the orientation wheel (26) and the other pivot mechanism (48) associated with each arm portion (44) being pivotally coupled to an outer portion of the first plate member (32) associated with said carrier wheel (24) and to the blade portion (42), each blade portion (42) further including a pivot mechanism (50) pivotally coupled to an outer portion of the second plate member (30) associated with said carrier wheel (24) whereby each spade device (40) is positioned in a substantially vertical orientation relative to the horizontal, said plurality of spade devices (40) remaining in a substantially vertical orientation when said carrier wheel (24) is rotated about its axis member (28).

17. The drive wheel assembly (22) as set forth in claim 16, wherein the blade portion (42) of said spade devices (40) comprises a plate member (51) having a substantially trapezoidal shape with a substantially flat surface area on each opposite side thereof, said plate member (51) having tapered side edges.

18. The drive wheel assembly (22) as set forth in claim 16, wherein the blade portion (42) of said spade devices (40) comprises a plate portion (51) having a substantially trapezoidal shape with a substantially flat surface area associated with each opposite side thereof, said plate portion (51) having tapered edges which terminate in a substantially narrow tip portion (52).

19. The drive wheel assembly (22) as set forth in claim 16, further comprising a drive mechanism (54, 56, 58) to drive the carrier wheel (24) about said axis member (28).

20. The drive wheel assembly (22) as set forth in claim 16, wherein said drive wheel assembly (22) is vertically adjustable with respect to the dredging apparatus (10).

21. The drive wheel assembly (22) as set forth in claim 16, wherein the distance between the axis of rotation of the orientation wheel (26) and the location where the pivot mechanism (46) of the arm portion (44) couples to the outer portion of the orientation wheel (26) is substantially identical to the distance between the axis of rotation of the carrier wheel (24) and the location where the pivot mechanism (48) of the arm portion (44) and the pivot mechanism (50) of the blade portion (42) coupled respectively to the second (32) and first (30) plate members of the carrier wheel.

22. The drive wheel assembly (22) as set forth in claim 16, wherein the rotation of the carrier wheel (24) drives the orientation wheel (26) at a substantially identical angular velocity about the pivot mechanism of said pivotation member (28) coupled thereto.

23. A method for assembling a drive wheel assembly (22) adapted for use for propelling a dredging apparatus (10) in a body of water, comprising the steps of:

rotatably coupling a carrier wheel (24) to the dredging apparatus (10), the carrier wheel (24) including an axis member (28) at the center thereof defining the center of rotation of the carrier wheel (24);

coupling a first member (32) to one end of said axis member;

coupling a second member (30) to the other end of said axis member;

pivotally connecting an orientation wheel (26) to the opposed end portion (38) of a pivotation member (34), said pivotation member (34) having opposed end portions, one end portion of said pivotation member being coupled to the center axis member (28) of said carrier wheel (24);

pivotally connecting a plurality of spade devices (40) to said carrier wheel (24) and to said orientation wheel (26), each spade device (40) including an arm portion (44) and a blade portion (42), each arm portion (44) having opposed end portions (46, 48);

pivotally coupling one end portion (46) of each arm portion (44) to the orientation wheel (26);

pivotally coupling the opposite end portion (48) of each arm portion (44) to the first member (32) associated with said carrier wheel (24);

pivotally coupling each blade portion (42) having a portion (50) thereof to the second member (30) associated with said carrier wheel (24); and

positioning said spade devices (40) in a substantially vertical orientation relation to the horizontal.

24. The method for assembling a drive wheel assembly (22) as set forth in claim 23, wherein said spade devices (40) remain in a substantially vertical orientation during said step of rotating said carrier wheel (24) about said axis member (28).

25. The method for assembling a drive wheel assembly (22) as set forth in claim 23, wherein the blade portion (42) of said spade devices (40) includes a plate member (51) having a substantially flat surface area with tapered side edges.

26. The method for assembling a drive wheel assembly (22) as set forth in claim 23, wherein said first (32) and second (30) carrier wheel members are spoked members.

27. The method for assembling a drive wheel assembly (22) as set forth in claim 23, further including the step of pivotally coupling one end portion (46) of each arm portion (44) to an outer edge portion of said orientation wheel (26).

28. The method for assembling a drive wheel assembly (22) as set forth in claim 27, further including the step of pivotally connecting the opposed end portion (48) of each arm portion (44) to an outer edge portion of the first member (32) associated with the carrier wheel (24).

29. The method for assembling a drive wheel assembly (22) as set forth in claim 28, further including the step of pivotally coupling a portion (50) of each blade portion (42) to an outer edge portion of the second member (30) associated with the carrier wheel (24).

30. The method for assembling a drive wheel assembly (22) as set forth in claim 23, further including the step of utilizing a drive mechanism (54, 56, 58) to drive the carrier wheel (24).

31. The method for assembling a drive wheel assembly (22) as set forth in claim 23, further including the step of providing a substantially vertical offset with said pivotation member (34) between the orientation wheel (26) and the carrier wheel (24).

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